Risk Perception, Adaptation and Behavior Change: Self-protection in the Wildland-Urban Interface

Donald G. MacGregor
MacGregor-Bates, Inc.
Eugene, OR

Melissa Finucane
Kaiser-Permanente Center for Health Research
Honolulu, HI

Armando González-Cabán
USDA Forest Service
Pacific Southwest Research Station
Riverside, CA

ABSTRACT

At the interface of the natural and built environments, communities and property owners are exposed to the potential ravages of wildland fire. Efforts to manage this threat have lead to outreach programs in which communities and homeowners can participate to protect themselves and their property from loss. Research from two broad areas, health-related behavior change and the social amplification of risk framework (SARF), has highlighted the role that risk perception and adaptation play in determining response to risk. Interventions designed to change knowledge, attitudes and behavior of those exposed to wildland fire risk face a number of *influence factors* due to socio-cultural factors that effect how advice about self-protection is interpreted and applied as part of everyday decision making. Agencies and organizations seeking to promote self-protective behavior change with respect to wildland fire risk are encouraged to focus their efforts more strongly on understanding the socio-cultural characteristics of the context in which their interventions are implemented.

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Corresponding Author: Donald G. MacGregor, MacGregor-Bates, Inc., PO Box 10105, Eugene, OR, 97440. tel: 541-942-5727 fax: 541-942-8041 e-mail: donaldm@epud.net

Introduction

Human habitation has made significant intrusions into forested lands, particularly in the Western US but in other parts of the world as well. At the interface of the natural and built environments communities and property owners are exposed to the potential ravages of wildland fire. Efforts to manage these threats have lead to outreach programs in which communities and homeowners can participate to protect themselves and their property from loss. Likewise, in the US the national fuels management effort that has sought to reduce the burden of volatile fuels on national forests and has as one of its motivations the reduction of fire-related risk in the wildland-urban interface. Both outreach programs and the national fuels program can be viewed as offering the public options for self-protection, and members of the public living in the wildland-urban interface engage in self-protection when they abide by the behavioral recommendations of outreach programs and provide support to fuels management efforts.

However, even casual observation reveals that people who are exposed to the risks of wildland fire do not always abide by the recommendations and guidelines offered by fire management authorities to protect their homes and property by undertaking voluntary self-protective actions, such as providing a defensible space around dwellings and removing flammable materials near buildings. Likewise, the public at large (including those exposed to the risks of wildland fire) is not consistently and uniformly supportive of hazardous fuels management programs that have as a prime objective the reduction of wildland fire risk. How can human behavior with respect to wildland fire risk be understood? What factors influence how those exposed to wildland fire risk translate that exposure into voluntary self-protective behaviors? From an agency perspective, these questions are central to determining the potential success or failure of interventions intended to yield a public response that is consistent with the risks as analyzed by the agency. From a public perspective, these questions provide opportunities for insights into the factors that motivate voluntary self-protection in general, and that shed light on the match between risk-reducing interventions and the people they are intended to benefit.

The Meaning of an Intervention

The concept of an "intervention" is central to behavior change in a host of social contexts, and particularly in the realm of health and safety. To "intervene" means quite literally to come in between one thing and another, such as between a health service provider and its patients or clientele, or between a federal agency charged with protecting citizens' safety and the citizens themselves. Interventions can be thought of as intrusions into what might otherwise be a natural process of human response (or lack of response) to events or circumstances that pose the potential for harm, with the intention of altering some aspect(s) of their knowledge, attitudes, and/or behavior in a beneficial way, at least as perceived by the developer of the intervention. A central assumption of most (if not all) interventions is that the economic and/or social cost of intervening is lower than if we do not intervene and leave people to adapt to potentially hazardous circumstances on their own. For example, we could allow people to "learn through experience" the potential risks and costs of exposure to wildland fire in the Wildland Urban Interface (WUI), or we could decide to intervene in ways that promote risk-reducing behavior.

Interventions of various types share a set of common features. They are *purposive* – that is, meaning they are developed based on a set of intentions, some of which are explicit (e.g., increase homeowner defensible space) and others of which may be implicit and more difficult to recognize (e.g., promote public trust and confidence, foster personal responsibility for outcomes). In some cases, interventions may be developed to impact directly one or more measurable objectives, generally having to do with knowledge, attitudes or behavior in some targeted population of individuals (e.g., homeowners in the WUI). To the degree that clear objectives are part of an intervention, its efficiency and effectiveness can be evaluated or measured.

Interventions are often the result of a *design process* that takes into consideration a method or approach for impacting a population of interest (e.g., media campaigns, town meetings, brochures, workshops), and some means of assessing or evaluating the strength of the implementation (how much intervention was achieved) and/or the effect of the intervention on outcomes of interest. The design process may be based on an analysis of risk or hazard, and to the degree that broad public knowledge of that risk or hazard is deemed important as part of the design process, the intervention may take on aspects of risk communication. Perhaps one of the more effective (if not most effective) interventions developed for the fire community was the "Smokey The Bear" campaign to increase broad public awareness of wildland fire risks and to promote public cooperation in reducing wildland fire potential (i.e., "only you can prevent forest fires") – so effective that subsequent interventions to promote public awareness and acceptance of the positive value of fire in forest ecosystems may be attenuated in their effectiveness.

We define the concept of an intervention because for many types of risks to public health and safety (including wildland fire), the public's understanding and experience of risk is often based, either in whole or part, on the *information environment* to which they are exposed. That information environment is based on a number of sources, many (if not most) of which are interventions of one sort or another. In the case of wildland fire, risk-based media campaigns and wildland fire news reports are part of the basis for public perception of wildland fire risks. Likewise, community interventions designed for the purpose of promoting defensibility in the WUI also make a contribution to the information environment. From a practical perspective, the matter comes down to how the public's (or targeted population's) response to an intervention compares with the response intended by its developers. In this paper, we take the perspective that voluntary response to risk-related interventions occurs as part of a dynamic and adaptive process by which individual and social factors interact.

Intervention Influence Factors: Lessons From Health-related Behavior Change

Behavioral and social scientists have long been concerned with the determinants of and conditions for behavior change, and particularly how to motivate and maintain self-protective behavior. Areas of principal concern have been health and safety where much effort has been expended to reduce the personal and social burden of mortality, morbidity and property loss through interventions designed to promote self-protection in, for example, motor vehicle operation, alcohol use, smoking, diet, and exercise. In the arena of health-

related behavior change a number of models have been developed and extensively researched with an eye to improving the quality and effectiveness of health and safety interventions.[1]

Interventions intended to produce self-protective behavior are generally implemented in a complex social context characterized by individual and socio-cultural factors that influence the potential for behavior change. In the case of behavior-change interventions that are based on risk assessment (as is often the case), many of these factors are not directly (or even indirectly) incorporated as part of the risk assessment that has identified a need for risk mitigation. Consider the case of wildland fire risk: the analyses that identify and support the need for social interventions in this area are largely based on technical and/or scientific models of ecosystems and the impacts of fire behavior on those ecosystems, as well as other models that characterize such features of fire as fire occurrence intervals, rates of spread, effects of fuel treatments on wildland fire and other features of fire that relate (directly and indirectly) to the risk fire poses to private individuals and their property. Absent from these models is a detailed explication of the social factors that influence behavior change with respect to wildland fire risk identified vis-à-vis these models. Thus, "agency" analyses that characterize wildland fire risk do not in themselves model the social context within which wildland fire risk mitigation takes place.[2]

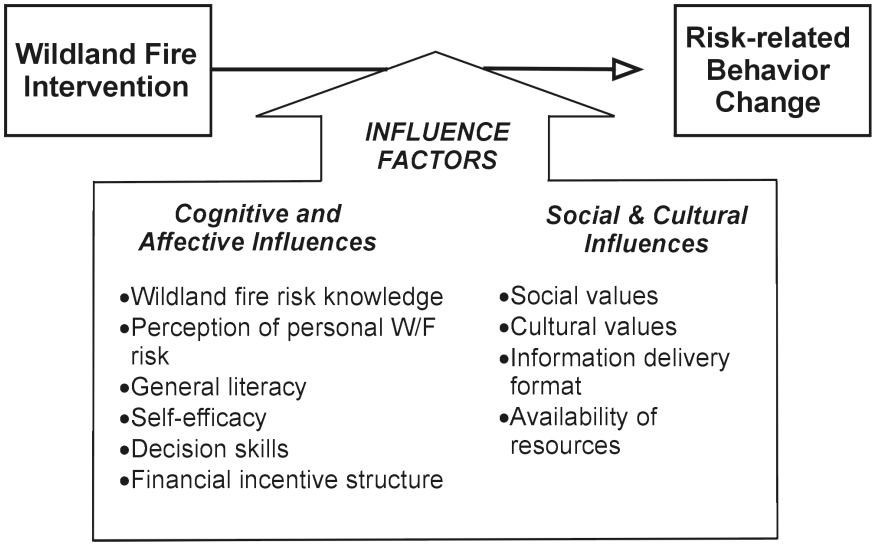

Figure 1. Model of influence factors that effect the impact of wildland fire interventions on risk-related behavior change.

[1] These include the Health Belief Model (Janz & Becker, 1984), the Theory of Planned Behavior (Fishbein & Ajzen, 1975), Protection Motivation Theory (Rogers, 1983), Transpersonal Theory (Prochaska & DiClemente, 1983) and the Cognitive-Social Health Information-Processing (C-SHIP) Model (Miller & Diefenbach, 1998). These models are described and reviewed in detail in other chapters in this volume and the reader is referred there for a more complete discussion.

[2] This characteristic of wildland fire risk assessment is shared as well by risk assessment applied to other health and safety concerns.

A general conceptualization of the relationship between wildland fire risk assessment, risk mitigation and behavior change influence factors is shown in Figure 1. Wildland fire risk assessment (in its various forms) leads to a characterization of risk as well as to the identification of changes and/or interventions that would reduce that risk. For example, the various recommendations made to homeowners (e.g., via Firewise) regarding defensible space and other self-protective measures constitute an intervention based on risk assessment. The public and community support sought by fuel treatment programs is also an intervention, in that it seeks to produce (and is partly dependent upon) positive public attitudes for prescribed fire and other forms of wildland fire risk reduction (e.g., brush removal, community defensible space). Interventions, however, are subjected to a number of influence factors (see Figure 1), including individual cognitive and affective influences, as well as socio-cultural influences.

Cognitive influences come in the form of knowledge, attitudes and perceptions that guide how individuals respond to behavior change interventions. Many of the models that describe how behavior change occurs assume that people hold beliefs about the potential for harm, and in the absence of these beliefs behavior change cannot be expected to occur. These beliefs can include perceptions of susceptibility to harm and its severity (Janz & Becker, 1984), as well as beliefs about the outcomes or effectiveness of behaviors they might undertake to reduce harm (Fishbein & Ajzen, 1975). Regarding wildland fire risk interventions, this suggests that people must believe they are personally at risk, that the risk is a significant and severe one, and that their efforts to reduce that risk would be effective.

Perceptions of susceptibility may be influenced by the seasonality of fire and the low probability of fire occurrence in a given location. Even if the annual probability of fire risk is aggregated over time, the likelihood that a given homeowner would experience an immediately threatening fire is relatively low. The presence of other risk mitigating factors, such as fire protection provided by local, state and federal agencies, can reduce this perception even further.

For homeowners to take steps to improve their safety, they must first recognize the need for taking such steps. Unfortunately, the tendency for many homeowners is the opposite. Indeed, the general tendency with regard to health and safety risk is over-optimism, a tendency to evaluate oneself as less likely to suffer the consequences of a hazard than other people. This tendency toward unrealistic optimism regarding one's personal chances of harm compared to that of one's peers has been the subject of much research across a range of health (e.g., Weinstein, 1989; Weinstein & Klein, 1996) and safety (e.g., Svenson, Fischhoff & MacGregor, 1985) hazards.

Risk is experienced in a cultural context. In recent years, research on risk has become oriented toward the influence of social and cultural processes. The desire to take greater account of the cultural context within which risk is experienced has resulted from a growing realization that risk means different things to different people and that cultural values weigh heavily in definitions of risk. This strain was already evident in early cross-cultural risk perception work done in the psychometric paradigm (e.g., Englander, Farago, Slovic, and Fischhoff, 1986; Goszczynska, Tyszka, and Slovic, 1991; Kleinhesselink & Rosa, 1991).

Even though risk perceptions may bear a similar general structure between cultures, specific hazards can be viewed very differently, with significant implications for risk acceptance and management. For example, Karpowicz-Lazreg and Mullet (1993) found that risk perceptions of the French public generally matched those of the American public except for a few specific hazards, among the most notable of which was nuclear power. Subsequence research has revealed that the generally greater acceptance of nuclear technologies on the part of the French is due in part to a greater public acceptance and trust in risk management and a greater need in France to rely on non-fossil fuel energy sources (see Slovic, Flynn, Mertz, Mays & Poumadere, 1996). Thus, differences in cultural context can dramatically influence how risks are perceived, as well as the prospects for successful risk regulation and management.

More recent work has cast cultural factors in terms of worldview and orienting predispositions that are related to underlying values and beliefs. This line of research, based on cultural theory, has emphasized risk as reflective of what is important to people vis-à-vis the social institutions they create (e.g., Douglas & Wildavsky, 1982; Wildavsky, 1988; Perri 6, 2005). Research on worldviews has highlighted simplifying strategies that predispose people toward different outlooks that have an influence over their judgments about complex risk issue, even though on the surface these worldviews appear to have little or no relation to risk (Buss, Craik, & Dake, 1986; Cotgrove, 1982; Dake, 1991; Jasper, 1990; Slovic & Peters, 1998; Peters & Slovic, 1996). Some of the more important worldviews identified to date include fatalism (e.g., "I feel I have very little control over risks to my safety"), hierarchist (e.g., "Decisions about safety risks should be left to the experts"), egalitarianism (e.g., "If people were treated more equally, we would have fewer problems"), and individualism (e.g., "In a fair system, people with more ability should earn more").

Cultural effects on risk perception can also extend to ethnicity groups and gender roles. For example, Flynn, Slovic, and Mertz (1994) studied the differential risk perceptions of males vs. females as well as white vs. non-whites. They found that white males consistently exhibited lower perceptions of risk across a wide range of societal hazards, and concluded that sociopolitical factors contribution to loss of personal control exacerbate perceptions of risk.

Cultural beliefs and values can lead to behaviors that directly clash with the behavior-change objectives of health and safety interventions. For example, among some Pacific Island cultures (and particularly Native Hawaiian cultures) the high cultural priority given to social and group values can lead to health-related behaviors (e.g., poor diet, insufficient exercise) that conflict with health-related interventions that emphasize the need for *individual* behavior change (Mau, Glantz, Serverino, Grove, Johnson, & Curb, 2001). To be effective, behavior change interventions need to take account of cultural factors that conflict with the objectives of behavior change interventions.

Self-protective decision making. For humans, many forms of self-protective behavior are instinctual and result from adaptive responses to environmental contingencies that have evolved over many successive generations (e.g., Wasserman, Young & Cook, 2004). However, not all forms of self-protection are so well encoded in our innate behavioral repertoire that they have become second nature; indeed, some have argued that evolutionary mechanisms of adaptation have been outstripped by the rapidly developing industrial and

technological world in which we live (e.g., Tooby & Cosmides, 1990) leaving us adaptively deficient in ways that we may not fully understand. In essence, the world around us is changing at a pace that is more rapid than our species can evolve to meet the adaptive demands placed upon it.

Although there is little doubt that humans have a natural aversion to fire and the damage it can do, it is also the case that fire itself has played a major role in the development of human societies. Historically, human societies have both feared fire as a natural, destructive force, and used fire to social and technological ends. The harnessing of fire by human societies represents one of the most profound changes in the ability of humans to achieve mastery and dominance over the natural world, increasing their safety and well-being. This dual nature of fire leads in itself to fire as a subject for decision making (MacGregor, in press). Indeed, many members of the public encounter fire-related decision making directly through plans for the use of prescribed fire as part of fuel management programs.

Interventions seeking to engage homeowners and community members in protective behavior carry with them both explicit and implicit decisions. Decisions are explicit when general guidance or direction is provided, but the individual homeowner carries the responsibility for translating the intent of the intervention into the specifics of their unique circumstances. For example, an intervention that focuses on the concept of defensible space may provide a prototypical plan for clearing trees and brush around homes and for appropriate storage of flammable materials. These intervention components essentially provide design criteria by which decisions about self-protection can be constructed. To the degree that those targeted by the intervention are able to directly translate such design advice into decision alternatives with clear and evaluable outcomes, the intervention may be more successful in achieving its objectives.

Decisions about self-protection are implicit when they (a) involve factors, considerations or criteria beyond the apparent scope of the intervention, and/or (b) frame the intervention (and its associated self-protection) as an alternative to other actions or protections that could be undertaken. For example, fire-related self-protection decisions implicitly involve an expenditure of resources on behalf of homeowners (e.g., time, money), though these factors may not be explicitly accounted for in the intervention through, for example, compensations or other incentives (e.g., intrinsic rewards such as personal recognition). The mismatch between the incentive structure for self-protection as conceptualized by those fielding the intervention (e.g., agencies) and the incentive structure of those targeted by the intervention (e.g., homeowners) can degrade the performance of an intervention, particularly when time and monetary resources take on sufficient weight to dominate long-term fire risk in the process of evaluating decision alternatives (e.g., Kahneman & Tversky, 2000).

A second source of implicit decisions relating to self-protection arises from competing interventions that can lead to *meta-decisions* about which of a number of interventions to address. In these conditions, individuals may be faced with a resource allocation problem, and for which a number of interventions may have to compete for homeowners' resources. This category of implicit decisions can be made more complex by interventions that involve conflicts and tradeoffs with other interventions that call upon

members of the public to either self-protect or to engage in risk management along other lines. For example, Monroe, Long & Marynowski (2003) examined a range of social interventions targeting Florida households. They found that multiple entities simultaneously fielded interventions relating to wildfire risk reduction, wildland habitat enhancement, energy conservation, water conservation and soil conservation. Although all of the interventions involved the reduction or mitigation of risk, adherence to some interventions conflicted with the goals of others. For example, energy conservation interventions emphasized planting trees near residences to provide summer shade; while wildland habitat enhancement interventions called for "layering" native plants near houses. Water conservation interventions promoted lowering water use, while soil conservation interventions called for increasing vegetative cover. The means proposed by all of these interventions potentially conflict with some of the steps that wildland fire interventions call upon homeowners to take. This can lead homeowners to frame social interventions relating to the natural environment as a decision problem concerning which from a number of interventions to address, particularly if the interventions themselves do not provide guidance about how to resolve the conflicts inherent in their proposals. Given the long history of research on human judgment and decision making that has identified the central role that problem simplification plays in how people reconstruct and reorder complex decision environments, it is unlikely that those targeted by a range of competing and seemingly-conflicted interventions will undertake a systematic tradeoff among competing intervention objectives.

Decision-making Capabilities and Skills. Decision-making capabilities are an important determinant of whether those targeted by an intervention are able to put it into action as intended by its designers. Although people routinely make decisions as part of everyday life, research on the quality of their decision making performance suggests that in many contexts their choices may be suboptimal, take too little account of important information, and are overly influenced by emotional factors. In some circumstances, individuals may put themselves at serious health and safety risk because they lack an appropriate decision model of their situation. For example, potential victims of "date rape" often do not see possible compromising situations as a series of decision points with alternatives, and tend to accept the outcome of a dangerous situation as an inevitable sequence of events. Providing individuals potentially exposed to such situations with a decision-making problem model has been found to promote greater awareness of self-protective behaviors (e.g., Downs, Murray, Bruine de Bruin, Penrose, Palmgren, & Fischhoff, in press). Likewise, some homeowners may perceive wildfire risk as an inevitable aspect of their decision to live in the WUI and need similar prompting to stimulate self-protective decision making.

Research has identified a number of criteria for decision competence, including the ability to (a) understand and remember relevant information, (b) structure a decision's dimensions and alternatives, (c) appreciate the personal significance of information, (d) temper impulsivity, and (e) rationally integrate information and reason about it (Applebaum & Grisso, 1988; Parker & Fischhoff, 1999; Rosenfeld & Turkeheimer, 1995; Finucane, et. al., 2002).

For wildland fire risk interventions, the concept of decision competence signals some important considerations. Interventions are often developed and fielded with little attention to how they interact with the decision making skills of the targeted population. Although

language factors (e.g., readability) are often addressed, other important decision components (such as an information integration model) are lacking in intervention design. As a result, interventions tend to focus on the behavior that is desirable (e.g., clear away vegetation), but give little attention to the decision making elements of the behavior (e.g., How much is enough? Which to do first?). Second, the decision competence concept emphasizes individual variability and differences in decision making. Whereas people vary in their decision competencies according to age, experience, socio-cultural circumstances and education, interventions tend to be designed as "one-size-fits-all." Third, the notion of decision competence implies that decision making is skill-based, and deficiencies can be remediated by careful intervention design and training. For example, information interventions could pose decision making scenarios relevant to some common dilemmas that targeted populations face, such as how to decide among alternative steps a homeowner could take to reduce the risk of wildland fire damage, assuming that they do not have the resources to do everything possible (e.g., time, money, physical ability).

The Social Amplification of Risk Framework (SARF) and Risk Adaptation

Over the past three or so decades, there has been a great deal of research dedicated to the topic of risk, including its perception, its communication, and its management. One of the primary motivations for research interest in this general area is the disparity that exists between risk as defined and assessed by technical experts (and technical analysis) and risk as perceived and reacted to by the general public. In particular, technological risks that have been gauged as relatively low by technical standards (e.g., nuclear power, industrial chemicals) have met with a disproportionately large reaction from non-scientists (e.g., Slovic, 2000) – that is, lay people tend to perceive such risks as much greater than would be expected based on quantitative risk measures such as expected loss or annual fatalities. Explanations for this disparity have generally been based on qualities of risks and hazards that are associated with their social context (e.g., familiarity, voluntariness, equitability), including the role and nature of media reporting (Flynn, Slovic & Kunreuther, 2001) and institutional factors associated with risk management (Freudenberg, 2003).

A conceptual framework that captures the richness of social response to risk is the Social Amplification of Risk Framework or "SARF" (Pidgeon, Kasperson & Slovic, 2003). SARF uses the metaphor of a physical "amplifier" to characterize how various stages of individual and social processing act to interpret and magnify risk events, thereby giving them meaning, and leading to impacts that spread outward from individuals initially effected by the event (e.g., victims) to higher-level organizations (e.g., government agencies, companies) and (perhaps) ultimately to larger social enterprises (e.g., land and fire management). Within the framework (see Figure 2), a dynamic process of interaction takes place between factors associated with individual (e.g., personal experience, perceptions, evaluation processes) and social (e.g., media, social groups) agents. The process is influenced as well by perceptions and attitudes that society holds for agencies and organizations associated with the risk management process, including the trust and confidence people have in the organization, the perceived quality of past experience of the organization in managing risks, and the ability of the organization to cooperatively address public issues.

Through processes akin to a social network, these interactions serve to impose meaning on a risk event and to modulate individual and social responses, often with the

general result of amplifying its impact through "ripple effects" analogous to "dropping a stone into a pond" (Pidgeon, Kasperson & Slovic, pg. 16). The framework has been used to account for risk events that have drawn stronger social reactions to a risk than seems warranted based on technical criteria (e.g., lives lost), such as health-related food risks (e.g., Frewer, Miles & Marsh, 2002; Finucane & Holup, 2005), and the stigmatizing effects of risk-related events on private property values (Flynn, Peters, Mertz, & Slovic, 1998).

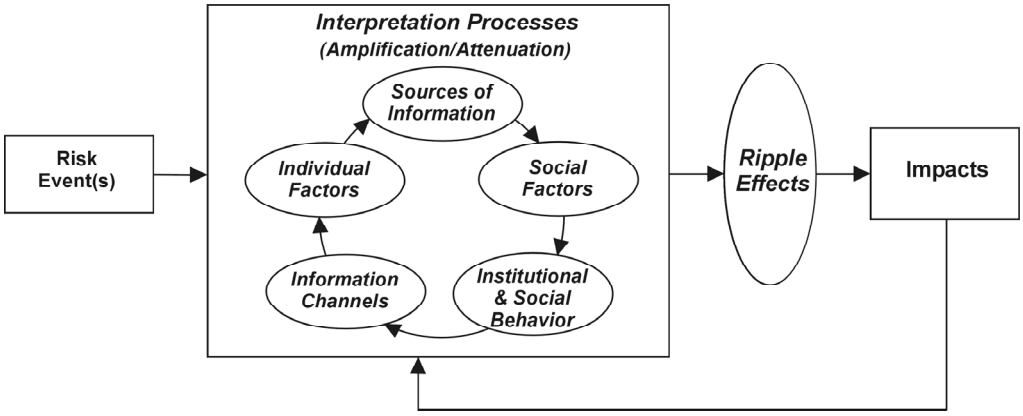

Figure 2. Major components of the Social Amplification of Risk Framework (SARF).

A less-studied aspect of SARF is its potential explanatory power for understanding the role that *adaptive processes* play in *attenuating* individual and social responses to risk. We can think of these responses as self-management of risk, which are adaptive in the sense that they occur in response to environmental contingencies (e.g., events, circumstances) and that lead to the subjective experience of stability in the individual (Piaget, 1952; Wasserman, Young & Cook, 2004). The essence of adaptation is in the nature of response to change or variability, and in the case of risk-related events that change comes about as part of the interpretive aspects of SARF and its associated ripple effects. These effects or impacts provide a stimulus for adaptive response, which may take the form of either assimilation or accommodation. *Assimilation* occurs when a risk-related event is interpreted and integrated within the individual in terms of pre-existing cognitive and/or emotional structures, such as associations to previous experiences or evocation of familiar emotional responses. Recent research has identified the central role that emotional and affective processing plays in the experience of risk (e.g., Lowenstein, Webser, Hsee & Welch, 2001; Slovic, Finucane, Peters & MacGregor, 2004), suggesting that not only cognitive but also emotional familiarity is part of risk adaptation.

Accommodation occurs when a risk-related event leads to either modification or reorganization of risk-related attitudes and perceptions, or to changes in behavioral regimes that influence risk perception. For example, the various dimensions associated with the "psychometric paradigm" of Slovic and colleagues has been widely researched as a general framework for risk perception, including controllability of exposure, familiarity, and predictability (e.g., Slovic, 2000). These same dimensions can also be viewed (at least in part) as a framework for adaptation through accommodation: individuals are motivated

(through behavior) to make the less controllable more controllable (e.g., by reducing exposure), the less predictable more predictable (e.g., by attending to information), and the less familiar more familiar (e.g., by gaining experience). In the case of wildland fire, Loomis, Bair & González-Cabán (2001) found that Florida residents who became more knowledgeable about prescribed fire also became more tolerant of prescribed fire risks, suggesting that educational interventions can increase familiarity, and decrease risk perceptions.

Risk Adaptation and Y2K. An example of risk adaptation can be seen in the public response to the Y2K phenomenon. As the world approached the change of the millennium, intense public interest became focused on the possible consequences of potential failures in computer technologies expected to arise from the mechanism for storing and calculating dates. Much effort was expended by government and industry to insure that critical computer systems had been properly "debugged." Though technical experts generally predicted that problems were likely to be either non-existent or minor, they could not conclude with certainty that no problems would occur. Thus, the broad public, exposed to an array of press reports concern Y2K and its possible consequences for their lives, could only conclude that the problem was not completely understood and that sure solutions had not been achieved. A series of national-level survey studies, conducted in 1998 and 1999 examined the time course of public reaction to the Y2K phenomenon (MacGregor, 2003). The results showed that as respondents became more aware of the Y2K issue and (potentially) its meaning for their personal lives, they became less concerned, and tended to see the problems occurring from Y2K as of lesser duration. In addition, with greater awareness of Y2K issues, they also were more likely to undertake greater self-management to decrease (ostensibly) the potential impact of Y2K on their personal lives. Thus, the more media attention was paid to the Y2K issue, the more concerns about Y2K were translated into adaptive responses to Y2K risk in the form of personal protective actions (e.g., avoid air travel, stockpile food & water, withdraw cash from banks). The change in public concern over the course of the two years leading up to Y2K may reflect an attenuation of risk through mechanisms of self-protective, adaptive response. Thus, concern is transformed through, for example, the "work of worry" (e.g., Janis, 1958; MacGregor, 1991) into a productive risk-management strategy that is itself an adaptive response to a risk issue.

Risk Interventions and Risk Adaptation. For many categories of risk, public awareness becomes enhanced through risk-related interventions. As discussed above, these interventions can take many forms, including media events, brochures, and community programs, undertaken to promote awareness and understanding of a risk issue and (sometimes) to promote behavior change. We can also view interventions in the context of SARF and consider them to be a form of "risk event" by which the general public and other social institutions (e.g., community leaders) become aware of a risk and subsequently engage in a process of interpretation and translation that leads to some sort of change, either in knowledge, attitudes or behavior. The dynamic character of SARF as a model of social risk response states that these changes themselves feedback and influence the interpretation and translation processes on which the response is based. Thus, perceptions of a risk targeted by an intervention are themselves modulated and potentially attenuated by the adaptive behavior the intervention is designed to provoke, leading to a stability or equilibrium of risk-related response to an intervention.

In the case of wildland fire interventions, and particularly those designed to promote behavior change, this suggests that as individual homeowners undertake protective actions in response to an intervention, perceptions of wildland fire risk will decrease, thereby decreasing the potential for further or additional protective actions. It is conceivable that there are also non-linearities with respect to the effect of taking any protective actions on perceptions of wildland fire risk. So, for example, homeowners who take one protective action from a suite of possible protective actions may attenuate their risk perceptions sufficiently to reduce the potential for further actions. Fielded interventions need to be studied carefully as part of evaluation to determine their ultimate impact on behavior change and to determine as well the relationship of incremental behavior change to the attenuation (or amplification) of wildland fire risk perception.

Conclusions and Policy Implications

How people manage the risks and hazards of daily life is influenced by a multitude of factors. The heart of the matter lies very much in the idiosyncratic nature of humans, their society and their culture – people are not the same everywhere and the differing individual and social values they hold exert strong influences over how and when they engage in self-protective behavior. To complicate the picture, behavior change interventions can overreach in terms of what they hope to achieve. This may be particularly so in the case of wildland fire management where years of intervening may be required to observe a demonstrable change in human behavior, and even longer to affirm (or disaffirm) that such changes bear a relationship to outcomes such as property losses or fire management costs. If there is a policy lesson in this observation it is that interventions to change public attitudes and behavior concerning wildland fire should be (a) long term, and (b) specific to targeted populations. Based on the diverse research outlined in this paper, the likelihood of success is increased to the degree that research is applied to understanding better the people, the problem and the interaction of the two.

While we believe that education as a tool for improving public awareness and understanding of wildland fire as a risk problem that individuals need to address according to their specific exposure circumstances, we also believe that education alone is not enough. Ultimately, the myriad decisions people make as part of their daily life will take appropriate account of wildland fire risk only if their decision making skills are sufficient, the need is perceived as worthy, and the behaviors they undertake are done so with an realizable expectation that they will be effective in terms that are meaningful to them. Risk-related behavior is adaptive, dynamic and highly sensitive to social context. The challenge is to develop potent interventions that emphasize the *maintenance of change* through ongoing intervention and the involvement of community leaders.

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